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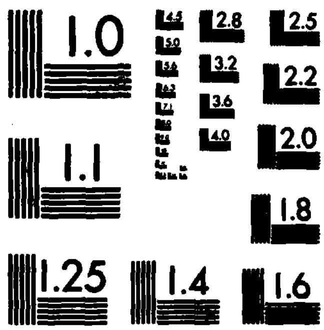

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THESIS

THE IMPACT ON MILITARY CONTAINERIZATION
OF A TREND BY THE CIVILIAN SECTOR
TOWARDS 40 FOOT CONTAINERS

by

Paulette R. Neshiem

December 1984

Thesis Advisor: Dan Boger

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between the shipper and the ship owner, the impact of container development on ship design, and military use of containers in peacetime and contingency operations are examined. The evidence of a trend by the commercial sector to move towards the 40 foot container is explored and its possible impact on the military is discussed. A study designed to assess the impact of this trend on the military and to determine the feasibility of using 40 foot containers in military resupply operations is developed. Additionally, alternate solutions are presented. The final chapter provides an analysis of the solutions presented and recommendations are made. Key

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The Impact on Military Containerization of a Trend by the Civilian Sector Towards 40 Foot Containers

by

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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

This thesis examines the impact on the use of containerization by the U.S. military for peacetime and contingency resupply operations of a trend by commercial shippers to move towards 40 foot containers. A brief history of containerization and its development in the commercial and the military sectors is followed by a discussion of current trends in the use of containerization. Such items as the economic relationship between the shipper and the ship owner, the impact of container development on ship design, and military use of containers in peacetime and contingency operations are examined. The evidence of a trend by the commercial sector to move towards the 40 foot container is explored and its possible impact on the military is discussed. A study designed to assess the impact of this trend on the military and to determine the feasibility of using 40 foot containers in military resupply operations is developed. Additionally, alternate solutions are presented. The final chapter provides an analysis of the solutions presented and recommendations are made.

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I. INTRODUCTION

In the event of contingency, the military must have the means to move massive tonnages of supplies and equipment at very short notice. It has been recognized by military planners that the only way contingency resupply can be moved is via ocean shipping (sealift). That the assets to provide this sealift capability must come from the commercial sector also has been recognized. [Ref. 1:p.9-11]

When the commercial ocean shipping industry began its move to containerization, little did the military realize just what impact that move would have on the methods used and plans developed to transport military cargo in the event of contingency. As with any other field of technical development, specialized equipment and handling methods have come to be developed for the efficient movement of cargo in containerization. Cargo handling gear, ships, port facilities, and even the containers themselves have evolved into highly specialized forms.

Recognition by military planners of the importance commercial assets will play in the event contingency resupply is required has resulted in the expression of concern over the availability and suitability of those commercial assets. Fueled by the lessons observed in the Falkland Islands Crisis, military planners have voiced grave misgivings over

the status of the U.S. flag fleet in terms of the total number of vessels that would be available in the event of contingency. Additional concern has been voiced over the unsuitability of many of those vessels for military operations. [Ref. 2:pp.37-39]

It is widely recognized, both by military planners and by the commercial sector that the container ships in use today are not well-suited to military operations [Ref. 1:p 11]. What has often failed to be recognized is that these ships are only one link in the containerization chain. The link as it were that drives all aspects of containerization is the container itself, at which very little attention has been directed.

A. SCOPE OF THE THESIS

Because the containers in use by the commercial ocean shipping industry are just as important to military contingency planning as are the ships needed to move them, this thesis examines the status of the container as it is used by both the military and the commercial sector. The objective of this thesis is to evaluate the current trend by the commercial ocean shipping industry to move towards the 40 foot container and to provide the framework for a study designed to evaluate the impact of that trend on military peacetime and contingency resupply containerization planning.

B. PREVIEW OF THE THESIS

The following chapter discusses the development and implementation of containerization within the commercial shipping industry. Chapter II addresses the advantages and disadvantages the commercial sector has realized from the use of containerization.

Chapter III provides a brief discussion of the development of containerization and its initial implementation by the military. A brief overview of military utilization of containerization in peacetime and planned use in contingency is provided.

Chapter IV looks closely at the current trends in containerization in both the commercial and the military sectors. These trends are compared and the results of that comparison are examined in terms of the impact on military planning.

Chapter V provides the framework for a study designed to assist military planners in evaluating the impact of the trend toward the 40 foot container on both peacetime and contingency resupply container operations. Additionally, other alternative problem solutions are presented and evaluated in terms of appropriateness of response.

Chapter VI presents the conclusions and recommendations of this analysis.

II. COMMERCIAL CONTAINERIZATION

As is true of so many other industries, the changes that have occurred in the ocean shipping industry since the end of World War II have been, to say the least, startling. New concepts in cargo handling, ship design and changing economic factors have combined to change the industry almost beyond recognition. What used to be a highly labor intensive industry is now almost completely machine run, from the vessels themselves to the methods used for handling the cargo. [Ref. 3:pp. 11-13]

Perhaps more than any other factor, the concept of containerization has been responsible for this change in the industry. Considered by many to be the force which has revolutionized the ocean transportation industry, the impact of containerization on ocean shipping has been compared to the impact of the assembly line on the automobile industry. [Ref. 4:p. 5] Containerization has resulted in the development of new ship types, new methods of cargo handling as well as new designs in cargo handling equipment [Ref. 1:p. 11]. But the changes have not stopped there; port design has been radically affected, with the result that the world of shipping with containers bears little or no resemblance to that of its predecessor, break bulk shipping [Ref. 5:p. 16].

A. CONTAINERIZATION DEFINED

Although lauded as a revolutionary force as a result of its impact on the transportation industry in general and the ocean shipping industry in particular, the container is nothing more than a box, too large for manual handling [Ref. 3:p. 11]. Containers are reusable and, although capable of being transported by truck, do not have permanently attached wheels. Modern containers are constructed of either steel, aluminum, or fiberglass. The material used for construction is based on the user's requirements in terms of expected life of the container and the physical conditions under which it will be used. [Ref. 5:p. 13]

The concept of containerization refers to the use of containers in conjunction with various modes of transport. Because of the standardization of containers, goods are able to be moved from origin to destination, via various modes of transport, without the goods themselves having to be unloaded or repackaged. [Ref. 5:p. 25] Containerization not only economizes on cargo handling, but provides greater protection to cargo from pilferage and damage [Ref. 6:p. 40].

B. COMMERCIAL DEVELOPMENT OF CONTAINERIZATION

The use of containers to transport cargo is by no means an invention of the twentieth century. From the earliest of times, man has recognized that the combining of multiple

units of goods into a single unit makes for an easier and more efficient method of transport. Boxes, barrels, crates and sacks have been used to transport goods.

As a system of transport, however, containerization is a purely twentieth century concept. Containerization provides a means of transporting various types of cargo via varied means of transport and thus provides the basis for intermodal transportation. Because it allows cargo to be transported from origin to destination, from the manufacturing site to the distribution point, containerization has become an integral part of the transportation industry as it exists today.

As with so many other innovations, rising costs and concern over decreasing profit margins provided the impetus that led to the development of containerization [Ref. 5:p. 5]. Traditional break bulk cargo operations, because they were highly labor intensive, caused shipping costs to rise rapidly after World War II [Ref. 5:pp. 1-3]. Because minimal use was made of machinery, break bulk operations were slow and tedious, to say nothing of dangerous [Ref. 3:pp. 11-13]. Individual units of cargo had to be manually loaded, stowed and discharged. Palletizing cargo, when suitable, reduced the amount of handling required, but did not obviate the necessity for manual handling.

Because break bulk operations are slow, the time spent by cargo ships in port was sometimes as much, if not more

than, the time spent in transit from one port to the next. Over and above the time required for the actual cargo operations, time was required to organize the labor. Stevedore gangs were contracted for on the basis of manually prepared stow plans. Last minute changes due to cargo availability or non-availability could necessitate the revamping of the stow plans and subsequent changes in the labor requirements. Labor arrangements generally had to be finalized prior to the commencement of cargo operations, so last minute changes could prove to be quite expensive. [Ref. 5:pp. 1-5]

Labor strikes, work slowdowns, unexpected delays resulting from inclement weather -- these are just a few of the occurrences that could contribute to the requirement of additional time to get a vessel loaded, stowed and underway. As new markets opened up around the world and as market competition increased, shippers became more demanding regarding the timeliness of cargo delivery. [Ref. 5:p 19]

Vessel port turn-around time was also of great concern to the ship owners [Ref. 3:p. 13]. Because in-port costs constitute a large part of all costs incurred as a part of vessel operations, the time required for cargo operations came out of owner profit margins. Additionally, it must be remembered that ships in port do not earn revenue; it is only in the carriage of cargo between ports that revenue

is earned. It is therefore of paramount concern to ship owners that vessels spend as little time in port as possible.

It was Malcolm McLean, owner of McLean Trucking Company, who was responsible for the implementation of containerization in the ocean shipping industry. Recognizing that substantial savings could be realized by both shipper and carrier if cargo handling requirements could be reduced, McLean felt that the answer was a container similar to that used in the household goods moving industry. This container would be packed at origin, loaded on a trailer, trucked to the part and loaded onto the vessel. Cargo discharge would be handled in a similar manner. The first trial run was made in 1956 with sixty containers loaded in New York for discharge in Houston. [Ref. 6:p. 11]

Interestingly enough, the ocean shipping industry more or less ignored the implications of what McLean was doing with containerization. Although Matson Lines did start running containers on its U.S. West Coast - Hawaii run shortly after this, it was not until McLean announced that his new shipping lines, Sea-Land, would start regular transatlantic container service that the ocean shipping industry treated containerization with any kind of serious interest. The year was 1966 and suddenly the ocean shipping industry found itself on the threshold of a new era. [Ref. 6:p. 11]

Some sources seem to feel that it was not the announcement of the existence of transatlantic container service

that suddenly awakened the ocean carriers to containerization, rather standardization is given the credit. Container standardization had been under discussion as early as 1961; however, it was in 1967 that the International Standards Organization agreement was signed. This agreement standardized container size at 8'x8' end sections, in lengths of 10, 20, 30 and 40 feet. Corner lifting devices were also standardized as a result of this agreement. The implication was that as a result of standardization, a world wide transportation system could be developed, with the container as its basic element. [Ref. 3:pp. 13-14]

Regardless of the cause, there can be no doubt that this move towards standardization signalled the start of containerization. From a total of five shipping lines operating container service from the United States in 1966, the number increased to 88 by 1969. It should be pointed out, however, that very few of these companies offered specialized container service. At best, container service was limited to what would fit on deck. The reluctance of ship owners to jump in totally to containerization may be attributed to various factors, not the least of which was the capital investment necessary to make the switch from break bulk operations to containerization. [Ref. 3:pp. 13-15]

Whatever may have been responsible for the reluctance on the part of the ship owners, it has been overcome. Today, containerization is the major method of transport utilized

by the ocean shipping industry. Break bulk shipping is becoming a thing of the past. Cargo ships are containerships; they are designed to carry containers and nothing but containers, unless designed for specialized commodities (e.g., bulk carriers, chemical and petroleum tankers). Today, the ocean shipping industry talks about fleets of containers, as well as the number of ships capable of carrying containers.

C. ADVANTAGES AND DISADVANTAGES OF CONTAINERIZATION

As was discussed earlier, the driving force behind the development of containerization as an active transportation concept was an interest on the part of both the shipper and of the carrier to reduce costs involved in the ocean shipment of cargo. By substantially reducing cargo handling requirements, not only have cargo handling costs been reduced for shippers, but port turn-around times have been reduced tremendously for carriers. [Ref. 5:p. 5]

Because a container is locked and sealed at point of origin and remains so until arrival at destination, pilferage has been substantially reduced. This is of particular concern for cargo owners who must view cargo pilferage as cargo loss. Although pilferage does still occur, it can generally be traced to either the loading or unloading of the container, rather than during transport. [Ref. 6:p. 40]

Cargo damage has been substantially reduced as well. Although some shoring is still required for cargo loaded into containers, cargo consignors are better able to mix and match their cargo to ensure maximum use of container capacity. The tighter the cargo can be loaded, the less damage that is likely to result from cargo movement in transit. Additionally, because containers are handled mechanically, there tends to be less stevedoring damage to containerized cargo. The container itself offers additional packaging protection for the cargo, particularly from the elements. [Ref. 5:pp. 5-6]

The tremendous capital investment required to support containerization is a primary disadvantage of the system [Ref. 5:p. 24]. Because containerization is a capital intensive industry, relying on specialized equipment, rather than a labor intensive industry, all participants experience high start up costs. Ship owners have had to design and construct new vessels that are capable of transporting large numbers of containers. Special equipment has had to be designed and purchased by both ship owners and port operators for the movement of containers. This equipment, which must be capable of handling fully loaded containers, must also have a high degree of reliability when faced with the ever increasing numbers of containers moving through the ports. [Ref. 5:pp. 16-17]

The containers themselves are expensive. Containers are not indestructible; in the normal course of cargo operations, containers do take a beating, not only as a result of equipment handling mishaps, but also from exposure to the elements. Although more and more container owners are looking at repair as a means of extending container lift, it is an expensive option. Under normal conditions of use, life expectancy for a container is considered to be from seven to ten years. [Ref. 7]

It must be recognized that containers themselves set restrictions regarding the types of cargo that are moved via containerization. Because of limitations on cargo weight and cube resulting from the physical design of the containers themselves, not all cargoes are suitable for containerization. As break bulk shipping has given way to containerization, shippers have been faced with rising costs for the shipment of non-containerizable cargo [Ref. 8].

Ports have been faced with serious land problems [Ref. 7]. Because large tracts of land adjacent to port areas are required to provide marshalling yards for containers, prots have faced tremendous difficulty and expense in attempts to keep up with containerization. The loss of revenue that can result from an inability to keep up with the demands of containerization is felt not only by the port itself, but by the surrounding metropolitan area as well.

The advantages of containerization for both the shipper and the carrier far outweigh the disadvantages. Once implemented, the question the ocean shipping industry must have asked itself at one time or another is, "Why did it take us so long?" Clearly containerization is the method of transportation that is here to stay; in the not too far distant future break bulk shipping may well be a thing of the past [Ref. 9:p. 36].

III. MILITARY CONTAINERIZATION

While great effort has been expended on explaining the economic implications of containerization on the commercial sector, not to mention the many reasons given for the commercial sector's impetus for developing containerization, a search of literature written about the development of containerization provides little information concerning the involvement of the U.S. miltiary in the early stages of the development of containerization. Credit, however, must be given to the U.S. Army for its efforts in regards to the development of the first extensive container transport operation [Ref. 5:p. 5]. An understanding of the military requirements and needs that led to the initial interest in containerization of cargo will provide a better appreciation of the role initially envisioned by military planners of containerization in contingency.

A. MILITARY DEVELOPMENT OF CONTAINERIZATION

One of the biggest problems faced by military logisticians during and after World War II was the damage and loss sustained by military cargo in the process of transportation. As a result, the U.S. Army directed that an analysis of its logistics system be performed; the result was the determination that some sort of cargo consolidation should

be implemented prior to transport. It was also recommended that a system of cargo protection be developed. A container made of metal appeared to offer at least a partial solution to the problem. [Ref. 5:p. 5]

Further analysis of the full range of military cargo revealed that fully 40 per cent of the total not only was suitable for containerization, but would also benefit from it [Ref. 5:p. 6]. As a result, the Army developed and introduced a standard sized CONEX (Container Express) box that was designed to be fully intermodal. Although the first containers experimented with by the Army were made of wood, metal containers were used in 1952 to transport military cargo from Ohio to Japan and from there to Korea. [Ref. 10:p. 32]

The CONEX box, which proved successful both in protecting the military cargo from pilferage and damage from the environment, also reduced cargo handling. Constructed of steel in two sizes (6'3"x6'10"x4'3" and 6'3"x6'10"x8'6"), they were capable of being mixed for shipping, stacking or storing. Also designed to be fully intermodal, they were capable of being transported by rail, truck, ship and army vehicles. The larger CONEX box proved to be the most popular size and was considered by many to have been the backbone of logistic support during the Vietnam Conflict. [Ref. 10:p. 33]

It was in Korea that the U.S. military recognized one of the greatest advantages offered by containerization. Because the Korean ports tended to be extremely congested, the time savings realized from container movement as opposed to traditional break bulk operations was significant. For the military, time savings cannot always be measured in terms of dollars and cents; rather, time savings are commonly measured as a result of the savings in lives realized as a result of the timely receipt of supplies. [Ref. 5:p. 6]

The military owned 80,000 CONEX boxes in 1959. By 1965, the Army and the Air Force jointly owned approximately 100,000 CONEX boxes. These CONEX boxes carried most of the military cargo destined for Vietnam at that time. The number of CONEX boxes was nearly doubled as the war escalated. The military was so satisfied with the results of containerization that full containership service using 20 foot van-sized containers was introduced for supply to Vietnam in 1967. [Ref. 7:p. 6]

Between 1968 and 1969, the military procured a total of 6,700 military vans (MILVANs). These containers, which measured 8'x8'x20', were purchased in order to expand the military's existing intermodal container capability. Equipped with a coupleable chassis and a moveable running gear (bogey), these containers constituted the military's container fleet. Of the total number of MILVANs procured, 4,500 had built-in restraint systems designed for the

transport of ammunition. These original restraint MILVANs are currently the only containers approved for the transportation of ammunition. [Ref. 10:pp. 34-35]

B. PEACETIME UTILIZATION OF CONTAINERIZATION

Recognizing that containerization has become the dominant mode of cargo transport within the ocean shipping industry, the Department of Defense has promulgated policy directing that as much cargo as possible will be containerized. This policy has resulted in ever increasing amounts of military cargo moving in containers. In 1970, for example, approximately 25 per cent of all military cargo moved world wide was moved in containers [Ref. 11:pp.2-4]. Most of this cargo was household goods. By 1978, approximately 90 per cent of all military cargo was containerized [Ref. 9:p. 36]. This trend has continued to the point where, today, the only cargos not moved in containers are those that do not lend themselves to containerization (e.g., petroleum). Additionally, most vehicles moved by the military are not transported in containers because it is either not economical because of quantities involved or because of size restrictions (military vehicles).

Estimates indicate that the total amount of cargo being containerized will continue to increase. Until recently, the Military Sealift Command (MSC) was operating break bulk and roll-on/roll-off vessels for the transport of military

cargo on selected trade routes. Many of these vessels have been laid up; therefore, cargo that was normally carried on them will now be booked to commercial carriers for transport and will be containerized.

The Military Sealift Command (MSC) provides container service to those military locations not serviced by commercial shipping companies. This container service provides resupply shipping for military bases in Antarctica, the Arctic, Wake Island and Diego Garcia. Previously, Army owned MILVANs were used to provide this service; as a result of their recall by DARCOM, commercial 20 foot containers have been procured by MSC under a lease-option-to-buy contract and are being used to provide this service. [Ref. 12]

C. CONTINGENCY UTILIZATION OF CONTAINERIZATION

Unlike the commercial sector, the military must plan for contingency situations when it will be necessary to transport tremendous amounts of cargo at very short notice. The military has not had an opportunity to exercise this tasking since the Vietnam era; it is therefore of paramount concern that military planners keep a close eye on both contingency requirements and the feasibility of military plans regarding those requirements.

Military planners estimate that roughly 95 per cent of all logistics support required in the event of contingency will have to be moved via sealift. The need to move this

quantity of cargo quickly demands the use of containerization. Recognition of this need is so strong that the Military Sealift Command has earmarked some 94,000 containers owned by commercial contractors and committed by them for short term military use in an emergency short of mobilization. [Ref. 13:p. 12] This estimate stipulates "short term" usage. No allowance is made for container casualties nor does the estimate provide for additional requirements should the emergency escalate or become a multiple front emergency.

Although the military does recognize the role containerization will play in strategic mobility, the concern of most planners seems to lie with the fact that most commercial ships are not suited for military operations [Ref. 14:pp. 12-13]. In order to be of maximum benefit in a contingency situation, a containership needs to be self-sustaining. This was one of the most attractive features of the old break bulk vessels in the eyes of the military: they were equipped with shipboard cranes capable of handling all cargo stowed within the ship. [Ref. 1:p. 11]

Modern containerships have no need to be self-sustaining since ports generally have cranes capable of handling all container operations. To equip a containership with its own cranes is a very expensive proposition, particularly if those cranes are not necessary or vital to vessel operations. It is unusual for a vessel to be so equipped; if so, it is generally because the vessel operators have

designed the vessel for a specific trade route or unusual operations where shore cranes are not available [Ref. 15:p. 13].

The problem for the military is that, in the event of contingency operations, there is no guarantee that port cranes will be operational or that they will even exist. In recognition of this problem, the military has been involved since the early 1970s in attempts to develop methods for discharging containerships without the use of shore-side cranes or even docks. "Over-the-Shore Discharge of Containership" (OSDOC), "Logistics-Over-the-Shore" (LOTS), and "Container Offloading and Transfer System" (COTS) are just three of these. To date, no ideal system has been developed; however, the lessons learned and expertise gained in this area have been invaluable to military planners.

Lessons learned from these programs have resulted in the development of new equipment designed to overcome the problems attached to discharging containerships without conventional port facilities. New techniques have been developed to counter the effects of ship movement and the difficulties contingent on the conduct of such operations under less than ideal conditions. [Ref. 16]

Another problem faced by the military planners in planning for contingencies with containerization is that of the characteristics of much of the cargo required by the military. Much of the cargo required by the military is unsuitable for containerization because of size and, in

some cases, weight. [Ref. 16] In an effort to deal with these problems, military planners have been actively involved in the design and testing of new container types. Additionally, attention has been directed towards optimal ship design [Ref. 13:pp. 12-14].

As a result, the conversion of the SL-7s was designed to afford capabilities that would alleviate these problems. Originally designed as super-containerships with tremendous speed capability, the ships have been converted to roll-on/roll-off ships, while retaining much of their container capability.

The SL-7 conversion is a unique solution for the military; unfortunately, the money and time required to modify all ships that may be required for use in a contingency are not available in sufficient quantities to the military. Recognizing that as time goes by, more and more of the ships built and owned by U.S. flag carriers will be non-self-sustaining containerships, the military has developed and is now acquiring flatracks. Flatracks enable the conversion of comtemporary containerships to fit the requirements of odd or out-sized military equipment. Although they are nothing more than platforms with collapsible sides, the military is hopeful that they will provide the solution to at least one of the problems presented by containerization in contingency. [Ref. 17:p. 9]

Contingency planning is difficult from the standpoint that all decisions made and plans formed must be based on estimates. An additional problem faced by the military is that of cost constraints. It is economically infeasible for the military to own all of the equipment that may be required in the event of contingency. Reliance on the commercial sector is absolutely necessary.

Unfortunately the needs of the commercial sector do not always parallel those of the military. Driven by the dictates of profit, the commercial sector is not always concerned with how its developments may impact on military contingency planning. Major changes often occur in the civilian sector which require the revamping of currently existing plans.

The military, once committed to a course of action, is often stuck with that decision. The complexity of the budgeting process, combined with congressional concern over military spending, and the inevitable inelasticity of the national budget -- all of these combined mean that the military cannot indiscriminately purchase equipment that it feels might be necessary in the event of a contingency. The phrase, "in the event of a contingency," is often viewed as providing insufficient justification for funding. [Ref. 18:pp. 1-6]

The Iranian Conflict and Falkland Islands Crisis have helped the military planners in providing justification for their

concern regarding contingency resupply. The lessons learned, particularly from the difficulties encountered by the British in providing resupply to a war half a world away, have provided the military planners with the credibility needed to back their concern for military capability to respond in similar situations. [Ref. 14:pp. 11-12]

Future military contingency planning will center more and more on the issues of resupply. The realization of the role containerization will play will become more and more obvious as time passes. Because the military cannot hope to possess sufficient assets to meet the needs for contingency resupply, reliance on the commercial sector will continue. It is imperative that military planners not only recognize this, but that they are aware of the direction the commercial sector is going in regards to equipment usage and development in order to ensure adequate contingency planning.

IV. CURRENT TRENDS IN CONTAINERIZATION

Containerization has evolved into a highly developed industry. Having recognized its inherent advantages of cost savings to both the shipper and the ship owner, continuing efforts have been made to further increase those savings. Responsiveness to shipper needs was identified as the key element for successful operation of container shipping service. To that end, the ocean shipping industry has left no stones unturned in its attempts to improve upon the original concept. [Ref. 19:pp. 32-33]

For the military also containerization has undergone changes. These changes have resulted from the recognition by military planners of the advantages containerization has provided the commercial shipping industry. Trends in military use of containerization have tended to develop in response to changes within the commercial sector. Acceptance of the role commercial shipping assets will have to play in contingency resupply has provided the military with the impetus to further explore and adapt containerization to its operational requirements. [Ref. 13:pp. 12-13]

A. CURRENT TRENDS IN COMMERCIAL CONTAINERIZATION

When looking at trends in the commercial usage of containerization, it is necessary to remember that the primary motivating force behind any decision made by either shipper

or ship owner is that of profit. Any businessman, in order to operate successfully within a system of free enterprise, must concern himself with the return he is able to recognize from his investments. Profit, after all, is what is left of revenue once costs have been met. Revenue and costs, then, must form the cornerstones of future planning in terms of response to the market.

The ship owner, then, when planning for future capital investments in terms of ships and cargo equipment, must consider those factors that will lead to increased net revenues. Revenues can be increased as a result of greater responsiveness to customer needs in terms of service, while decreased costs can result from increased productivity from ships and cargo equipment.

Productivity has been closely looked at by the ocean shipping industry. Although the size of the ship plays a significant role in productivity, the industry has recognized that container size itself is of equal importance. [Ref. 19:p. 32] From the standpoint of the shipper, of course, the size of the container must be of major concern, since container size impacts on handling costs. For the ship owner, container size provides responsiveness to shipper need, and is at least a partial key to market competitiveness.

Being competitive in the market is, however, only a part of the picture. In order to assure an acceptable profit margin, it is necessary for operating costs to be

kept as low as possible. The costs involved in the ocean portion of vessel operations remain relatively constant, regardless of the load carried by the ship [Ref. 19:p. 32]. In order to spread those costs as thinly as possible over the total number of containers carried, it is necessary to carry as many containers as possible.

Most ship owners recognized early on that simply building big containerships was not the answer to the problem. Tremendous capacity does a profit margin no good whatsoever if that capacity is not being used. Responsiveness to shipper needs provides the link between size and use. Thus, container size has come to be considered as a manipulative factor. [Ref. 20:p. 59]

It is interesting to note that in the early days of containerization, container size was determined, in fact, solely as a result of shipper requirements. Sea Land, as the pioneer in containerization, ran 35 foot containers, not as a random whim, but because that was the size van that was used in its trucking operations. By standardizing the size, Sea Land was able to offer the shipper the concept of intermodal transportation, with door to door service. [Ref. 5:p. 7]

Matson Lines, who became the second U.S. shipping company to enter into containerization, opted for 24 foot containers. Serving the U.S. West Coast - Hawaii trade route, Matson

selected the 24 foot size because it corresponded to west coast highway restrictions in effect in the late 1950s. [Ref. 21:p. 35]

In addition to these sizes, 10 foot, 20 foot, 27 foot and 40 foot containers made appearances, all designed to cater to the needs of specific shipping groups. In 1961 the International Standards Organization Technical Committee 104 (ISOTC 104) adopted as the standard for container size the 35 foot container. Selected primarily because it was a size on which all participants of the Committee could agree, it was the size used by Sea Land and was designed to cater to the intermodal needs of the U.S. shippers. Although 40 foot containers were making an appearance in the U.S., their length was not accepted by all states for legal highway drayage. [Ref. 22:p. 73]

As the European countries actively entered into the use of containerization, other container sizes became standardized by the ISOTC 104. The 40 foot containers, as well as its 20 foot and 10 foot derivatives, were particularly favored by the Europeans. Because of limitations imposed by narrow roads and the difficulties of transporting the large containers over old European roads, the 20 foot container was preferred on trade routes running out of Europe, while the 35 foot and 40 foot containers were most popular on the trade routes running out of the U.S. [Ref. 22:p. 74]

Container size remained relatively stable until 1981 when American President Lines (APL) announced its decision to test 45 foot containers on the U.S. West Coast - Far East trade routes. This dec. ion was made by APL because cargo shipped over these routes tends to have a higher volume to weight ratio (and is considered to be cube cargo), for which this longer length was specifically designed. Although 5 feet longer in length, the weight capacity of the 45 foot containers has been maintained at that set for the 40 foot containers under ISOTC 104. APL has made it very clear that these 45 foot containers are not designed to replace the 40 footers; rather, they were designed to meet a specific need on a specific trade route. [Ref. 23:p. 16]

The decision to run the 45 foot containers has been, at least to this point and as far as future indicators show, very successful. In August of 1984, APL's 45 foot containers were run via train to the East Coast of the U.S., completing a U.S. East Coast - Far East intermodal transportation route. The indications are that this full circle intermodal use of 45 foot containers will become the routine for APL, at least over this trade route. [Ref. 24] The Vice President for Marketing for APL, Mr. Mike Uremich, stated the following when questioned as to the impetus behind the firm's move to the larger containers:

> "We run our ships where the market tells us to run them, not where we have historically run them, not where it might be operationally convenient." [Ref. 20:p. 59]

This quote might have just as well been attributed to Malcolm McLean, who followed much the same philosophy in his development and initial implementation of containerization.

Although much might be said regarding industry trends in terms of vessel design, discussion will be limited to the current trends in container size. Despite the various choices available to the commercial shipper, the tendency is for certain sized containers to be more commonly selected. The forces driving the selection of these sizes are not easily recognized, however.

There can be no doubt that the trend in containerization is toward larger boxes. Matson Lines has announced that it will forsake its 24 foot containers on its overseas routes and will use the 40 foot length [Ref. 25]. Even Sea Land, who not only owned the world's fleet of 35 foot containers, but operated a complete intermodal transportation system with 35 foot containers as its basic unit, has announced that by 1986 it will be running only 40 foot containers [Ref. 7]. Although American President Lines, as discussed previously, has introduced the 45 foot container, there are no intentions at this time to discontinue use of the 40 foot containers in their fleet [Ref. 26].

The general concensus, at least among the U.S. flag carriers, is that the container of the future will be the 40 foot container. It is expected that, rather than the 8'6" height in use today, the containers of the near future

will be 9'6" in height [Ref. 26]. A drawback to this greater height is the low clearance of bridges and overpasses in many parts of the world [Ref. 22:p. 75].

What is interesting is the dominance of the 40 foot container over its rivals, the 35 foot and 20 foot containers. The reasons for the emergence of the 40 foot size as the preferred container for most shippers are many, all of which are based on economics [Ref. 7].

The 40 foot container has traditionally been more popular on the trade routes running from the U.S. to the Far East and to Europe, while the 20 foot container has been preferred on the trade routes running out from Europe. A possible explanation for this trend may be the difference in the types of cargo shipped over these routes. Those cargos shipped from the U.S. tend to be light in weight, while those cargos shipped out of Europe to the rest of the world tend to be heavier. [Ref. 22:p. 75] Since box size selection is based on the compatibility of the container characteristics with those of the cargo, finished goods, for example, which tend to be lighter in weight in relation to volume than do raw or semi-finished goods, are better suited to the larger container size. Prior to 1978, the majority of containers delivered to fleet owners were 20 foot containers; deliveries of 40 foot containers rarely exceeded one-third of the number of 20 foot containers delivered [Ref. 27:p. 73].

The actual ratio of 20 foot containers to 40 foot containers in the world's container fleet was 2.46 units to one in the early 1980s; by the start of 1983, however, the ratio was 2.8 twenty foot units to each 40 foot unit (Figure 1) [Ref. 28:p. 59].

	1980	1983
20 foot	1,297,771	2,141,987
40 foot	526,462	763,041
Others[1]	101,483	86,970
Total	1,925,716	2,991,998

[1]Others includes 10ft., 24ft., 27ft., 30ft., and 35ft.

Figure 1. World Container Fleet by Length
[Ref. 28:p. 72]

The comparison of box size by totals owned is interesting in that the U.S. owned container fleet is substantially larger than that of any other flag of ownership. In 1983, the U.S. owned approximately 44.8 per cent of the world's total container fleet. The next major owner, the United Kingdom, accounts for the ownership of 12.4 per cent of the total world's fleet. This represents an increase for the United Kingdom from 8.93 per cent in 1980, and a decrease for the U.S. from 54.6 per cent of the total world's fleet of that same year (Figure 2) [Ref. 29:p. 41].

	1980	1983
United States	1,004,531	1,286,722
United Kingdom	186,640	400,954
Other	722,227	1,304,323
Total	1,913,398	2,991,999

Figure 2. World Container Fleet by Country of Ownership [Ref. 28:p. 61]

Analysis of 1983 statistics shows that 64.5 per cent of all containers owned by U.S. shipping and container leasing companies are 20 foot containers, while 30.4 per cent are 40 foot containers, and 4 per cent are 35 foot containers. Of the 51,108 total 35 foot containers in the U.S. fleet, 88 per cent are owned by Sea Land. The ratio of 20 foot to 40 foot containers in 1983 was 2.1 twenty foot containers to each 40 foot container (Figure 3). [Ref. 30:pp. 38-41]

	20ft	35ft	40ft	Others[1]
Leasing Companies	760,325	0	289,861	4
Shipping Companies	16,950	37,385	78,568	11,106
Military	0	0	0	5,658[2]

[1]Others includes 45ft., 30ft., 27ft., and 24ft.

[2]This is composed of 1,559 general cargo MILVANs and 4,099 ammunition restraint equipped MILVANs. [Ref. 25]

Figure 3. U.S. Container Fleet - Dry Van Totals for 1983 [Ref. 30:pp. 38-40]

By 1986, the date selected by Sea Land for the completion of the conversion of their shipping operations to 40 foot containers from 35 foot containers, the U.S. container fleet can be expected to show a somewhat different composition. Sea Land, who has opted for conversion rather than replacement of the majority of its 35 foot containers [Ref. 7], will substantially diminish the world's supply of 35 foot containers. The result will be an increase to the 40 foot portion of the U.S. fleet of approximately 4 per cent [Ref. 30:p. 38]. This projected change includes no allowance for asset growth.

Analysis of the 1983 statistics also indicates that 81.5 per cent of the U.S. container fleet is owned by leasing companies. Their portion of the world's container fleet accounts for approximately 36.5 per cent of the total number of containers available world-wide. [Ref. 29:p. 43]

These statistics would seem to belie indications of a trend by the ocean shipping industry to be moving toward the larger (40 foot) container. Remembering that the statistics used were based on the makeup of the container fleet as of January 1983, the statistics for 1984 can be expected to show a different picture, if for no other reason than the start of conversion of the Sea Land container fleet. Additionally, forecasts of purchasing activity by U.S. container leasing companies indicate a movement toward the 40 foot container [Ref. 31:pp. 18-19].

Reports from U.S. container leasing firms state that, during the first six months of 1984, they were making their first major purchases of containers in recent years. Attributing their decisions to increase their fleet size to the up-swing in the world's economy, the leasing companies have indicated a belief that demand for leased containers will continue to increase. Most of the purchases made by Xtra, Itel, Sea Containers, Transamerica and TOL have been for 40 foot containers. For example, of the 20,000 containers ordered by Xtra, the ratio of 40 foot containers to 20 foot containers was 3:1. [Ref. 31:pp. 18-19] Itel ordered 11,000 forty foot containers out of a total 13,000 containers [Ref. 32]. Sea Containers follows this trend by ordering an estimated 70 per cent of their total 30,000 container order in 40 foot lengths [Ref. 31:p. 19]. Transamerica's order was for a total of 16,000 containers, of which 14,000 were 40 footers [Ref. 33].

While these numbers would indicate a preference for 40 foot containers, it must be stressed that many of these orders are an attempt by container lessors to balance out their currently existing oversupply of 20 foot containers. This oversupply, which resulted from tremendous purchases of 20 foot containers made in the 1970s and the early 1980s, was a result of a general recession in world wide shipping. [Ref. 31:pp. 18-19] It is anticipated that the 20 foot

container will continue to hold its own in markets other than those dominated by U.S. shippers [Ref. 32].

Representatives of the three largest U.S. flag carriers -- Sea Land, American President Lines and U.S. Lines -- when interviewed, indicated that the trend in the container industry is most definitely towards the larger box. As discussed on pages 36-38 of this thesis, the general consensus among these three is that the 20 foot container has lost its popularity with shippers and ship owners alike for a variety of reasons, all of which show marked indications of continuing to grow in importance over time.

Probably the single most important reason given for this trend towards the 40 foot container, at least within the U.S. shipping industry, is the cost of intermodal transportation. As a result of deregulation of the trucking industry and of the Staggers Act, which allows for an 80 foot maximum truck-trailer length, it has become uneconomical for shippers to move 20 foot containers over the road [Ref. 7]. Line haul costs are nearly the same and, in some cases, are the same for 20 foot containers as they are for 40 footers. The result is that the shipper actually ends up paying more per ton of cargo moved in a 20 foot container than he pays for the movement of that same cargo ton loaded in a 40 foot container. [Ref. 8]

The same is true for the movement of containers by rail. The deregulation of intermodal traffic under the Staggers

Act allowed the railroads to enter into competition with the trucking industry for the movement of containers. Because of standard railcar configuration, the optimum load is two 40 foot containers. The loading of four 20 foot containers per flatcar is not feasible because the weight of the loaded containers will exceed the maximum allowable payload weight of the flatcar. Shippers are finding, therefor, that costs are higher per cargo ton for 20 foot containers than they are for 40 foot containers moved by rail. [Ref. 34:pp. 51-52]

It is imperative that shippers watch closely all costs incurred in the process of moving their product to market, as the total of these costs contribute to the final cost of their product. The greater these costs, the higher the market price must be in order to ensure receipt of desired profit. Sensitivity to transportation costs is crucial if desired profit margins are to be realized.

Ocean shipping costs have also contributed to the trend towards the larger container. Because many rates are based on actual tonnage shipped, it is in many cases cheaper per ton of cargo shipped if 40 foot containers are used. The cargo handling costs involved in the use of 20 foot containers are double those for 40 foot containers. And lastly, because the tariff rates are based on what the market will bear over specific trade routes, ship owners themselves are discriminating against the use of the small containers.

In order to avoid getting "stuck" with a backlog of containers on one end of a route, for example, the tariffs are set so as to discourage the shipper from using the less popular sized containers [Ref. 26].

Another factor influencing the trend towards the 40 foot container is the cargo itself. Commercial cargo tends to be what is considered cube cargo; that is, it tends to use up the cubic capacity of the container before the weight capacity. The high volume capacity of the larger container is ideally suited for this type of cargo, particularly since container tariffs are frequently based on actual tonnage loaded, rather than container capacity.

As a result of the current strength of the dollar, the movement of cargo is primarily towards the United States. Although this means an adverse impact on the nation's balance of trade, the trend is expected to continue. According to the Secretary of the Treasury, Donald T. Regan, indications are that the dollar will maintain its strength through the rest of this decade. [Ref. 35:p. 165] Although there are many who scoff at this optimistic outlook, the migration of many U.S. manufacturing concerns overseas would indicate that there are many believers [Ref. 36:pp. 168-169].

The implications are important for the ocean shipping industry. A strong dollar means increasing imports and decreasing exports. The American consumer will have the products of the world market available at prices lower than

ever. Even if (and there are those who insist it should be when) the dollar loses its position on the world market, the American consumer will have developed a taste and a preference for many of these foreign-made goods. This consumer preference will be sufficient to create an on-going demand for many of these goods, despite increasing prices. As a result, trade will continue to run into the U.S., even as the dollar loses its value on the world market, and U.S. goods become competitive on the world markets again. [Ref. 37:pp. 172-174]

Forecasts from the major U.S. flag shipping companies indicate that shipments from the Far East are expected to increase [Refs. 7;26;38]. As the Asian countries continue to develop their industrial bases, more and more of their products will find their way into the international markets. Goods produced by these countries are generally better suited to the larger containers as they tend to be finished goods. An indication of this is provided by the apparent success of the use by American President Lines of 45 foot containers on its Far East trade routes. [Ref. 20:pp. 59-61]

Currently, the limiting factor on the use of the larger containers (both the 40 foot and the 45 foot) on the Far East trade routes are the limitations of many of the roads [Ref. 26]. However, as the industrial bases of the Asian countries grow and efforts are made to modernize in accordance with this growth, efforts to upgrade all aspects of the

in-country transportation facilities in order to handle the increased trade and its requirements can be expected [Ref. 33].

Sea Land, with the replacement of its 35 foot container fleet with 40 foot containers, has already found that the number of 20 foot containers in use by commercial shippers has diminished rapidly. On their European and Mid-East trade routes, so few 20 foot containers are being booked by shippers that cargo planners have limited available space to deck stowage. The result is that at most, only 20 to 30 containers of this size are being run per week on these routes. [Ref. 7]

B. CURRENT TRENDS IN MILITARY CONTAINERIZATION

Just as in the commercial world, usage of containerization by the military has undergone changes since its initial development. Better understanding of the capabilities and the potential benefits to be gained from containerization have resulted in increased use and dependence on the container for the movement of military cargoes. [Ref. 9:pp. 34-35] This usage has not been limited to the use of containerization for contingency planning, however; the military also uses containerization for the peacetime resupply of its forces throughout the world [Ref. 12].

1. <u>Peacetime Usage</u>

Recognizing that containerization was going to become the dominant means of cargo movement within the ocean shipping industry, DOD determined in the late 1960s that containerization would also have a profound effect on military shipping policy [Ref. 39:p II-N-2]. Since that time, it has been the expressed policy of DOD to ship all containerizable cargo in containers [Ref. 10:p. 37]. The result is that almost 90 per cent of military cargo shipped today is shipped in containers [Ref. 40:pp. 1-3].

In the implementing of this policy, DOD relies heavily on the use of commercially owned containers and on the commercial shipping lines of the U.S. [Ref. 10:p. 37]. The Military Sealift Command (MSC), as DOD's single manager for sealift and ocean transportation, is responsible for the coordination with the ocean shippers for the movement of DOD cargo [Ref. 9:p. 35]. Until recently, MSC also moved DOD cargo in Navy-owned and chartered assets over many routes where commercial shipping was available; this was done, not as a means of providing competition for commercial operators, but in order to exercise those assets in peacetime. However, current MSC policy dictates that, if commercial shipping is available, it will be utilized, even at the expense of under-utilization of Navy assets. The result is a further increase in the miltiary utilization of commercial assets. [Ref. 41]

Commercial resources, however, are not available to meet all of DOD's shipping requirements. For those locations where commercial service is not available, MSC provides service through the use of Navy-owned or chartered ships and containers. Prior to 1984, this service was provided with MILVANs owned by the Army. Part of the original purchase of MILVANs made in the 1960s, these MILVANs were recalled by DARCOM and were replaced by commercial 20 foot containers under the terms of a lease-option to buy contract. The 680 containers procured for this pool are used to provide resupply to Antarctica, the Arctic, Wake Island, and Diego Garcia. [Ref. 12]

Additionally, the MILVANs equipped with ammunition restraints that were procured by the Army in its initial purchase of containers made in the 1960s remain today the only containers authorized for the transport of ammunition. Because commercial shippers are prohibited from carrying ammunition in the quantities required by the military for the resupply of even routine peacetime needs, the military must provide assets for the shipment of its ammunition. [Ref. 10:p. 34] Using traditional break bulk vessels and MILVANs, military ammunition is shipped on a regular basis from military ammunition ports on the U.S. East and West Coasts to overseas locations [Ref. 16].

Containers currently considered to be part of the military's inventory of transportation assets are 20 foot

containers [Ref. 42:pp. 1-1 - 1-12]. The military, when using its own containers is not faced with a decision as to size in regards to container utilization. This is not true, however, for the majority of the cargo shipped by the military for peacetime resupply. When booked to commercial carriers, resupply cargo is carried in commercial containers and is treated the same as commercial cargo [Ref. 8].

When using these commercial carriers, the military is faced with the same cost considerations and constraints commercial shippers face as concerns container size selection. As a result of line haul costs, port handling costs and cargo handling costs, the military is finding that the 40 foot container offers in many cases the cheapest per-cargo-ton mode of transportation. [Ref. 8] In view of this cost efficiency, the Military Traffic Management Command (MTMC), which is the agency assigned the responsibility as DOD's single manager for military traffic, land transportation, common-user ocean terminals, and intermodal containers, has promulgated guidance to military shippers which stresses the importance of selection of the most cost efficient size of container. [Ref. 43]

MTMC, who for many years equated efficient container utilization with the percentage of container capacity used, now recognizes that true efficiency is a result of per ton costs. As a result, MTMC guidance to shippers now recommends

the use of 40 foot containers over 20 foot containers, particularly when linehaul and handling charges are considered. [Ref. 43]

The result is that more and more of the cargo booked by the military to commercial shippers is being moved in 40 foot containers, rather than in 20 foot and 35 foot containers [Ref. 43]. According to American President Lines, DOD has reduced its use of 20 foot containers booked to the Far East from approximately 1000 per month to current approximations of less than 300 per month [Ref. 26].

2. Contingency Planning

Early in the 1970s it became obvious to military planners that break bulk shipping would not be available in the numbers required for contingency resupply. For the military, containerization use in wartime presents unique problems, solutions for which must be found. Peacetime use of container assets is far different than that to be experienced during contingency. [Ref. 39:pp. II-N-2 - II-N-3]

The first problem that the military planner is confronted with is the type of cargo that the military must move within the context of a contingency scenario. Military equipment tends to be much heavier than does commercial cargo. In addition, military cargo is not of uniform size; rather, it tends to be large and oddly shaped. Examples of this cargo are tanks, ammunition, and field equipment; items

of this type bear little resemblance to the nice, neat packages that commercial shippers are accustomed to dealing with.

Heavy cargo tends to reach container weight limitations before reaching the cubic capacity limitations of the container. Small containers, with their higher weight to cubic capacity ratio tend to be more efficient for military purposes. A 20'x8'x8'6" container can carry 20,320 pounds maximum weight according to International Standards Organization standards, while a 40'x8'x8' container can carry a maximum of 30,480 pounds [Ref. 22:p. 74]. Weight to cubic capacity ratios are 15.9 pounds per cubic foot for the 20 foot container and 11.9 pounds per cubic foot for the 40 foot containers. As an example of the military weight to cubic capacity ratio, ammunition can only be loaded one layer deep in containers, regardless of the size of container selected. If a 20 foot container is used, the container floor will be completely filled. However, this is not true of the 40 foot container. Military plans regarding the contingency movement of ammunition are, therefore, all geared around the use of 20 foot containers. [Ref. 16]

The Army is required, as a result of contingency plans currently in existence, to maintain ammunition and containers sufficient to meet the demands anticipated for the first three days of contingency operations. This means, for example, that 3000 MILVANs must be available at all times

for loading of ammunition out of the military ammunition port of Sunny Point. The assets to meet this requirement are those MILVANs that were procured as a result of the Army's initial purchase of containers in the 1960s. [Ref. 44]

But ammunition accounts for only a small portion of the material that will be needed in the event of contingency. Current contingency plans call for 95 per cent of the needed cargo to move by sealift [Ref. 45:p. 29]. It is estimated that 60 per cent of the supplies needed for the secondary phase of "amphibious lift," the follow on assault, will be moved via sealift [Ref. 45:p. 38]. Reinforcement and resupply shipping for a NATO contingency would have to move an estimated 11 million tons of military cargo from the United States alone. This estimate does not include the fuel that would have to be moved (17 million tons) or the amount of equipment and supplies that would have to be moved from Great Britain to the continent. [Ref. 2:p. 39]

These are only estimates of the amounts of cargo that would have to be moved. Until such time as a contingency actually occurs, there is no way of knowing how accurate these estimates are. Regardless of the accuracy of these estimates, commercial assets of containers and vessels will have to be available to move the vast majority of this cargo [Ref. 17:p. 6].

Utilization of commercial containers and vessels becomes the first of a group of major problems. The commercial

shipping industry is gradually moving away from the break bulk vessels that are so admirably suited to military operations. Because of their ability to carry items of almost any size or weight, as well as their ability to be selfsustaining, break bulk vessels are well suited to operations virtually anywhere in the world. However, as the commercial world has expanded its use of containerization, the number of break bulk vessels in the world shipping fleets have decreased. In the U.S. flag fleet, for example, break bulk ships have decreased from 123 in 1978 [Ref. 46:pp. 23-24] to 86 in 1982 [Ref. 47:pp. 12-13]. This compares to the growth of containerships in the U.S. flag fleet from 163 in 1978 to 242 in 1982 [Ref. 48:p. 28]. The result is that the majority of vessels available to the military for contingency resupply will be commercial container ships.

The military has recognized the implications of this and has begun looking at means of adapting commercial ships to fit the need of military cargo. Through the development of "customized" containers, such as flatracks and seasheds, the military anticipates being able to carry otherwise non-containerizable cargo on commercial container ships. [Ref. 49:p. 68]

Flatracks, which are of the same length and width as standard containers, have end frames which fold inward for stacking. Designed to provide a framework around cargo that is not easily containerized, flatracks enable containers

to be stacked above and below them. [Ref. 49:p. 68] Best described as platforms, the military currently owns six units; there are no plans to purchase additional units, however, as it has been determined that sufficient units can be obtained from commercial container leasing companies [Ref. 42:p. I-5].

The sea shed unit is nothing more than a large open-topped box. Measuring 40 feet long and 25 feet wide, it fits into the space normally required for several 40 foot containers. The steel floor in the sea shed is hinged and can act as a hatchway, providing access to the units stacked beneath it. A series of sea sheds loaded next to one another serves as a large, flexible "tweendecks" stowage area. Designed to handle heavy and outsized military cargo, such as vehicles and aircraft, the sea shed project has not yet been completed. [Ref. 49:p. 68]

The second major problem faced by the military in the utilization of commercial container ships in a wartime scenario is the requirement for the specialized equipment necessary for lifting containers on and off containerships [Ref. 49:p. 68]. All major ports in the world have cargo handling gear pierside, alleviating the necessity for containerships to be self-sustaining. Because of the tremendous expense involved in the purchase and installation of such equipment on-board these vessels, ship owners are naturally reluctant to install such equipment if it does

not prove necessary for vessel operations. [Ref. 15:p. 13] As a result, the majority of the containerships constructed in the last few years are not self-sustaining, a trend that shows no signs of changing [Ref. 50].

In the event of a contingency, however, there is no guarantee that ports where the cargo will be off-loaded will have sophisticated cargo handling equipment in place or operational. The location chosen may be nothing more than a beachhead and may not be a port at all. If so, it will be necessary to have available means to unload containers from the vessels while in the stream. Cranes will have to be available that are capable of lifting containers from the vessels onto barges, pontoons, or temporary piers.

The Army has been working on this problem since the early 1970s. The Over-the-Shore Discharge of Containerships (OSDOC) program, as well as the Logistics-Over-the-Shore (LOTS) and Container Off-Loading and Transfer System (COTS) tests have all been attempts by the military to develop methods of handling the discharge of containers under less than favorable conditions [Ref. 51:p. 77]. While an ideal system has not yet been developed, a thorough understanding and appreciation of the problems to be faced with such an operation have been gained.

The craneship modification program, which is being carried out by the Maritime Administration under the auspices of the Navy, will provide a partial solution for the problem

of off-loading non-selfsustaining containerships. Designed to be a part of the Ready Reserve Force (RRF) of the National Defense Reserve Fleet (NDRF), the 11 ships scheduled for conversion under this program will be modified by the installation of large marine cranes. Their primary mission will be to unload ships brought alongside. These craneships, which are designated as T-ACS ships, will carry their own lighters and causeway sections, as well as military cargo. [Ref. 49:p. 68]

A third problem faced by the military planners is the source of the containers required. Although a pool of containers owned by U.S. flag shippers and lessors has been identified, it is difficult to estimate how adequate this pool will be in terms of meeting the contingency requirments. Under optimal conditions, this pool of containers will be available exactly as required by the military; there is no guaranteeing this availability either in terms of numbers or location. Additionally, the problem of controlling and guaranteeing the make-up of that pool in terms of desired container size presents problems for military planners [Ref. 32].

Up to this point, all discussion of container size has been in regard to cargo requirements. It must be pointed out that not all ships can carry all sizes of containers. Vessels designed to carry containers of a specific size, such as 20 foot or 35 foot, are not always capable of

carrying a variety of container sizes. And even though the popular belief is that vessels designed to carry 40 foot containers can always carry 20 foot containers, this is simply not so [Ref. 16]. Modification of container cells or the coupling of two 20 foot containers, although minor in terms of material and time required, in a time of contingency can prove to be extremely difficult to accomplish. Military planners must be aware of such modification requirements and plan accordingly.

Once again, however, it must be remembered that only estimates can be developed. Not until the actual requirements are known can any kind of certainty be felt in regards to the forecasts of contingency requirements. It is imperative that military planners ensure the issue of container availability be addressed in detail, not just in terms of gross numbers required.

The movement of containers once ashore presents another problem that must be resolved prior to any contingency. It is unlikely that containers will be discharged on the beach. Transport will be necessary. Because containers are designed to be transported on trailers of some type, contingency planners must also plan for their availability. Once again, the size of containers that are available must be taken into consideration when developing requirements for trailers.

Sufficient quantities of tractors and trailers in the appropriate mix of sizes will do little good, however, if sufficient and adequate cargo handling equipment is not available ashore to lift those containers on and off of the trailers. Military planners must take care that consideration is given to the maximum load weights and container dimensions that may be encountered in the pool of containers that will be available for contingency use to ensure that cargo handling equipment ashore will be adequate.

Containers, once loaded, are easily moved over the road or via rail. In a wartime scenario, however, just as there is no guarantee of the existence of ports or of pierside container cranes, there is no guarantee that road or rail facilities will exist. In order to meet the need for which they have been loaded, the containers must be gotten to the battle lines or designated resupply areas. Tractors, trailers and cargo handling equipment are all critical if the containers are to arrive at their designated destinations. These items must be available in sufficient numbers and must be capable of handling containers of varying size and weight.

It can be argued that the old CONEX box was and still is the ideal container size for the movement of troop equipent under wartime conditions. These small containers (6'3"x6'10"x4'3" and 6'3"x6'10"x8'6") are easily transported over rough terrain and can be moved by a troop unit using

its standard field transportation equipment. The only method available for moving them on the containerships that will be available for contingency resupply is to load them into commercial containers and unload them once they are ashore. However, problems inherent to the use of containerization and commercial containerships will still exist.

C. MILITARY REQUIREMENTS AND TRENDS AS COMPARED TO CURRENT COMMERCIAL TRENDS

The trends in military development and use of containerization, while designed to increase the use of commercial containers and ships by the military, have tended to be geared primarily towards customizing container design for military usage. Although the military has moved towards the use of the 40 foot container in peacetime for shipping by commercial means, it has not looked closely at the larger container in terms of its own peacetime container resupply system nor has it fully explored the use of the larger container for wartime use. [Ref. 25] Having developed and used the 20 foot container successfully, the military appears to have decided that it will stay with that size container [Ref. 42: 1-2 - 1-3].

This decision, while based on experience, must be reevaluated in terms of the current trends in containerization occurring in the commercial sector. Only if sufficient numbers of 20 foot containers are available, to say nothing

of the vessels required to move those containers, can the military say that larger containers are of no value for military operations.

Rather than looking at the larger containers, the military has concerned itself with designing and developing specialized containers to solve the problems inherent in the movement of its outsized and oddly shapped equipment by commercial assets [Ref. 49:p. 68]. Because the military recognizes that containerships will constitute the majority of the fleet of commercial vessels that will be available for use during a contingency, the decision has been made to develop systems that will ensure their adaptability to military needs.

In the process of this, many military planners have failed to keep an eye on what is happening within the commercial ocean shipping industry. The movement towards the larger container would appear to have passed unnoticed by these planners. Even though the commercial shippers are increasing the numbers of large containers in their fleets, military planners continue to talk 20 foot containers. In fact, during discussions with military container and cargo people, the response was overwhelming in assurance that the 20 foot container would remain the contingency container. Not only that, but it was repeatedly heard that there was no need for the military to concern itself with

the possibility of a commercial trend toward larger containers, if in fact such a trend exists. [Ref. 44;25;12]

The assumption seems to be that, because the military prefers the 20 foot container, the commercial carriers will continue to make them available in the quantities required by the military for contingency operations. The military belief would appear to be that the commercial shippers have a responsibility, in fact, to ensure that these containers remain in sufficient quantities simply because the military prefers them.

On the commercial side of the house, this feeling apparently does not exist. As the costs for moving and handling cargo continue to rise, expectations of commercial container owners are that the costs for the use of the 20 foot containers will also continue to rise. [Refs. 7;26;38] As they do, their popularity with commercial shippers will continue to decline. As this happens and as it becomes necessary for container owners to replace their 20 foot containers, the logical decision will be to replace them with the size for which there is more shipper demand.

Recognizing the popularity of the larger container, ship owners will, when the time comes to construct new vessels, opt for those designed to carry the larger containers, just as they are currently doing. Ports, as they observe this continuing trend towards larger containers, in order to remain competitive and in order to ensure their

ability to handle the larger containers, will purchase equipment designed to handle the larger containers. Equipment manufacturers, who must respond to customer needs if they are to remain competitive, will stock and deal in those pieces of equipment that are capable of meeting the increased needs of these larger containers.

D. IMPLICATIONS OF THESE DISCREPANCIES

The implications here are clear. First of all, because of the trend of the commercial sector to move away from the 20 foot container, the military may not have 20 foot containers available for its use in the event of contingency. Although the 40 foot container is not the best suited size for military operations, particularly in view of the conditions that can be reasonably expected in a wartime scenario, the military must be aware of and be capable of dealing with the assets that will be available to it in the event of a contingency. This is particularly true since the U.S. military must rely heavily on commercial sealift assets.

Secondly, even though those ports currently served by the military containerization system (Antarctica, the Arctic, Wake Island and Diego Garcia) are constrained to the use of the 20 foot containers as a result of their current port structure, the possibility exists that in the not so distant future these ports may have the capability of handling larger containers. It may also prove to be more efficient for

their operations for these locations to accept the larger containers. Military cargo handling equipment must be replaced eventually; even military piers and ports do require and do receive updating and modernization. In time, because commercial equipment will have the capability to handle the larger containers, the military will find itself paying for capability that it may not be able to use.

Military planners have, in the past five years, been presented with the dangers that can arise from complacency and a failure to consider all aspects in regards to contingency resupply planning. The implications of the Falkland Islands Crisis alone should have taught the military the necessity of keeping its collective mind open to all possibilities, particularly regarding the commercial shipping sector. It is a well recognized fact that it is from them that the assets necessary for successful operation of resupply shipping must come. Of what use will those assets be if the military has failed to keep abreast of the trends in their development?

E. SUMMARIZATION OF CURRENT TRENDS IN CONTAINERIZATION

It would be hard to argue that current trends in commercial containerization are not towards the 40 foot container; to the contrary, all indicators, both economic factors and equipment design, point to a growing preference for the larger container on the part of both the commercial shipper and the vessel owners. Although military cargo planners

have justification for their preference for the 20 foot container, it is imperative that, as discussed on pages 60 and 61 of this thesis, they recognize this trend within the commercial sector. More importantly, it is imperative that the military recognize the implications of that trend as concerns contingency and future peacetime container operations.

Given that the military has limited resources but must prepare for all possible contingency situations based solely on estimates as to requirements for resupply and equipment, it would appear to be advantageous if a study were performed which would provide indications of just what the impact of the trends within the commercial ocean shipping industry would be on the miltiary's plans for future operations. Only if the miltiary is aware of what the implications of these trends in regards to their plans would be, can an appropriate line of action be determined.

V. RECOMMENDATIONS

In view of the prior discussion concerning the dependence of the military on commercial assets for peacetime and wartime resupply operations, it is imperative that DOD maintain an awareness of trends within the commercial industry. Awareness of trends will enable DOD to forecast the impact such trends will have on its plans and operations. Through the forecasting of the impact of trends, DOD will be able to recognize possible equipment shortfalls and will be in a position to take responsive action.

It is recommended, therefore, that DOD conduct a study designed to assess the impact of the trend by the commercial ocean shipping industry to move toward the use of the 40 foot container as the dominant container length. This study should be designed to evaluate the future capability of the military to use the 40 foot container in both its peacetime resupply operations and its planned wartime resupply operations. In addition, the study should attempt to determine at what point in the future the impact of the trend towards the 40 foot container will be felt by the military in the performance of its planned operations.

Such a study should not be considered as a solution in itself. It should be regarded simply as a means of providing a forecast. The results of such a study must be analysed;

the analysis of the study results will provide military planners with a tool to be used in the determination of and appropriate response.

DOD may not, however, feel that such a study is a necessary part of the effort required to assess the implications of the trend towards the 40 foot container. Evaluation of current action on the part of U.S. flag shippers may indicate to military planners that such a study is not necessary. Within the context of this chapter, two alternative solutions are presented and discussed. However, it is recommended that a study of the type proposed be implemented prior to any discussion of possible plans of action.

Before DOD can embark on a discussion of plans of action regarding possible container shortfalls, military planners must assess the impact such a trend in the commercial industry could have on military operations from the standpoint of ship and container availability, container handling capability, compatibility with cargo requirements and shortfalls of cargo handling equipment that may result from such a trend. In effect, it is necessary for military planners to develop as accurately as possible forecasts of the military's ability to deal with the implications of such a trend.

A. GENERAL STUDY DESIGN

As presented in the introduction to this chapter, the recommended course of action is the conduct of a study designed to assess the impact of the trend towards 40 foot containers on military peacetime and wartime resupply

operations. The study, which will forecast the future implications of this trend, should cover a period of approximately 20 years. This period of time has been selected in order to provide a sufficiently long forecast so that action may be taken by DOD to correct shortfalls the study may indicate. It must be recognized that such a study, concerned as it is with future plans and estimates, can only be considered to be an estimate in itself. Nevertheless, even as commercial industry estimates future needs and develops strategic plans based on those estimated needs, so, too, must the military project for future requirements. The overall design of the study is as shown in Figure 4.

As part of the assessment of the impact of the trend towards the 40 foot container, the study must determine the ability of the military to utilize the 40 foot container in its resupply operations. This determination must be based on the availability of equipment capable of handling containers of this size, as well as the compatibility of military cargo with container characteristics. Additionally, any restrictions that may exist or be expected to exist within port structures must be carefully considered for their impact on operations using the larger container.

The question of efficiency must be dealt with in terms of the impact the 40 foot container will have on efficient utilization of assets. Results of the study should provide an assessment of when the trend towards 40 foot containers

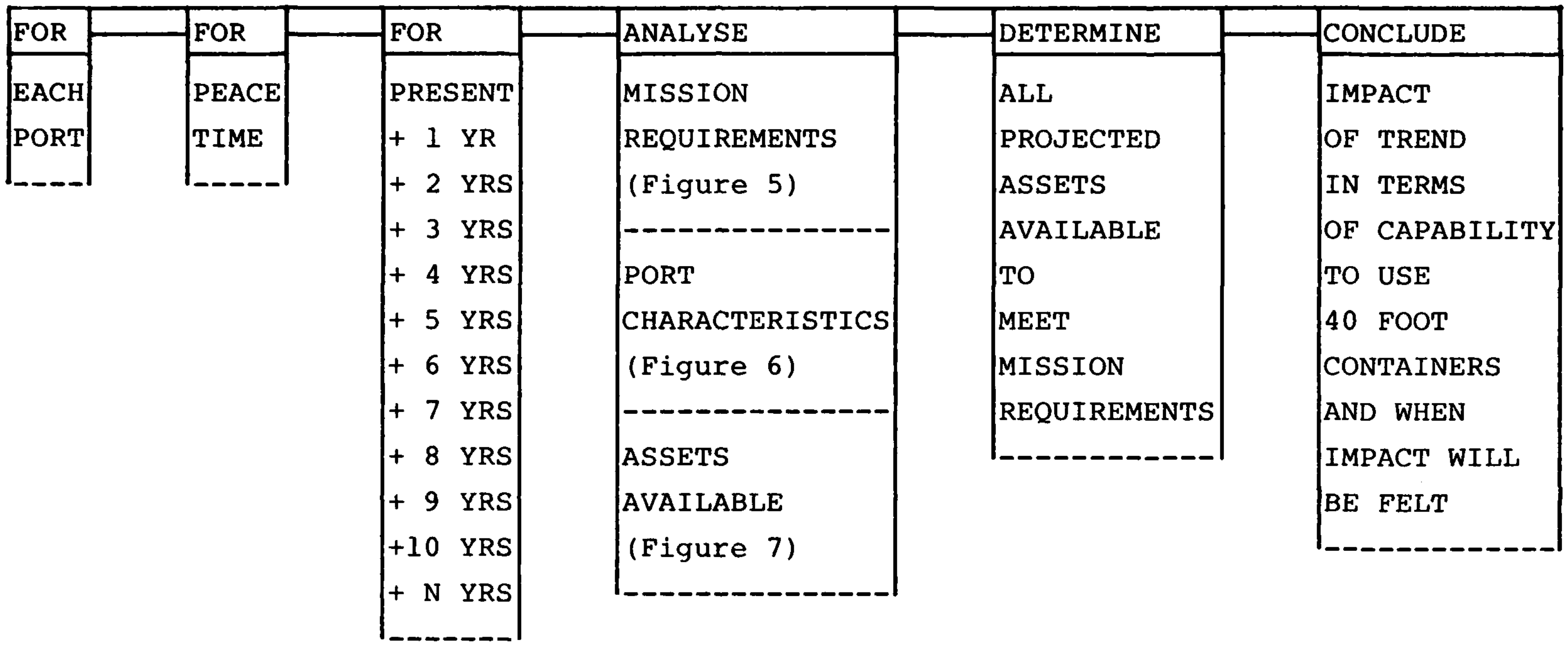

Figure 4. General Study Approach

can be expected to impact on military operations. Additionally, the study should provide an indication of how that impact will manifest itself.

It is recommended that such a study be conducted in two parts; the first will concern the impact of the trend on military operated peacetime container resupply of Antarctica, the Arctic, Wake Island, and Diego Garcia, and the second will concern the impact of this trend on resupply in contingency. Both studies would require the establishment of a baseline based on currently existing capabilities and port structures. Through analysis of currently assigned missions and current contingency plans, future requirements and anticipated changes can be forcasted.

Both studies would be conducted along similar lines in regards to development of future growth and development. Because the analysis results must reflect container flow rates and any restrictions that may exist, the studies must examine all factors that may impact on these flow rates. These factors should include such things as container utilization rates, vessel availability, cargo handling equipment capabilities, port structure, transportation infrastructure, and container handling capabilities. It must be stressed that there will exist, for each port or location examined, characteristics that may impact on container operations. Examples include such things as environmental factors, port structure and transportation infrastructure limitations.

These characteristics must be carefully evaluated for impact on planned operations.

Those ports currently served by military container service for peacetime resupply are also vital for contingency operations. It is recommended, therefore, that the study of peacetime container operations be completed prior to the start of the study of contingency operations.

1. Study of Peacetime Container Operations

In the conduct of a study designed to assess the impact of 40 foot containers on the peacetime resupply of Antarctica, the Arctic, Wake Island, and Diego Garcia, it is imperative that the concept of future operations be kept in mind. Current port structure and capabilities, in many cases, prohibit the use of anything larger than the 20 foot containers currently in use. In some cases, Antarctica for example, current equipment capabilities are often strained even in the handling of containers of this size [Ref. 52]. However, it must be kept in mind that these problems exist as a result of current port or equipment capabilities. Future mission demands may indicate the need for expansion and upgrade of existing activity structure and capabilities. It is necessary that the future needs of these locations be identified.

The data that will provide the baseline of this portion of the study concerns the current status of resupply operations for each of the four ports. Data must include all

information concerning port structure, as well as actual resupply requirements as they currently exist. It is imperative that the information gathered be as complete and as detailed as possible. Figure 5 provides a possible format.

Information about the current port structure can be divided into three categories; the first is that concerning the physical structure of the port itself; the second is that concerning the capabilities of the port and receiving activity; the third is that regarding the local infrastructure as it impacts on the movement of containers (Figure 6). The information to be gathered concerning the physical structure of the port itself should include such things as harbor depth and availability of moorings, number and type of piers available, depth of water at pier(s), number and length of berths available at pier(s), as well as any restrictions that might impact on container operations.

The information required concerning port capabilities is somewhat more involved, as it must include data on all aspects of container handling. This includes information on everything from the equipment that is currently available for use to the amount of area available for container marshalling. It is necessary that detailed listings of cargo handling gear be developed, to include types of equipment available, how many of each, exact capabilities in terms of container handling (e.g., size, reach, weight capacity), age and current condition, location of cranes and any other

VARIABLE	ATTRIBUTES	MEASURES	SOURCE
Current resupply requirements	Total quantity	Weight Cube	Supply Depot Activity Supply Department
	Commodity	Weight Cube Total units	
	Frequency of delivery	Per quarter/ month	
	Quantity per delivery	Weight Cube Total units	
Anticipated growth	By year	Percentage based on current requirements	Fleet Commanders POM submissions
	Total quantity required to support growth	Weight Cube	
	Commodity	Weight Cube Total units	
	Frequency of delivery	Per quarter/ month	
	Quantity per delivery	Weight Cube Total units	
Flow rate required	Total quantity of cargo	Weight Cube	Fleet Commanders POM submissions Supply Depot Activity Supply Department
	Commodity	Weight Cube Total units	
	Container requirements	20 ft. 40 ft.	
	Container utilization rate	20 ft.: percentage of: cube weight 40 ft.: percentage of: cube weight	

Figure 5. Mission Requirements

VARIABLE	ATTRIBUTE	MEASURE
Port structure	Harbor	Depth
	Moorings	Number
	Piers	Number Type Depth of water
	Berths	Number Length
	Restrictions	
Port capabilities	Cargo handling equipment	Type Quantity Size Reach Weight capacity Condition Age Location
	Storage/staging facility	Location Size: Total number of: 20 ft. containers 40 ft. containers
	Cargo transport equipment	Number of tractors and capabilities Number of chassis and size Age Condition
	Flowrate	20 ft. containers 40 ft. containers Weight
Local infrastructure	Road conditions	Type of construction Type of surface
	Road limitations	Weight Length Width
	Bridge/tunnel limitations	Height Weight Width Length
	Receipt facility	Location Size: Total number of: 20 ft. containers 40 ft. containers

Figure 6. Port Characteristics

non-mobile pieces of equipment, as well as exact explanations of any restrictions or limitations that might exist for the use of this equipment. All information available concerning those areas designated for container receipt or marshalling, including the size of the area and current system used for the storage of containers must be obtained.

Additionally, it is necessary to develop complete inventories of tractors and chassis available for the movement of containers from the site of discharge to receipt locations. All equipment used by the receiving activity must be inventoried; data should include age, condition and capabilities. Again, any restrictions or limitations that may exist as a result of equipment currently in use should be noted.

Information must be obtained regarding the structure of the road system over which the containers are moved. This should include such things as restrictions on weight, length and height of load moved. Road surface and construction should be discussed, particularly as it may impact on weight limitations.

Once all of this information has been gathered, it is necessary to obtain an evaluation of the capability of current port structure, equipment and infrastructure to handle current resupply requirements. This information, which should be in terms of container flow rates, needs to be detailed for each step in the process of handling and moving containers. Flow rates for discharge, port processing, movement through the port, loading on trailers, movement to

receiving activity - all must be developed. It is these flow rates that will be used to determine the efficiency of current container operations. Particular attention must be given to limitations or restrictions that currently exist that may impact on flow rates currently existing in the movement of 20 foot containers.

These flow rates, which should be those currently used by cargo operations personnel for planning purposes, should be provided in terms of containers handled per hour, as well as measurement tons moved per hour. Data should be obtained for both actual rate and for estimated maximum capability. In those cases where maximum capability and actual flow rates are not in agreement, the cause for discrepancy must be noted.

The best source for this information will be from the military activity assigned the responsibility for port operation in each of the four locations. Because of changing physical conditions and the often idiosyncratic nature of local operations, the information obtained from those individuals who must deal with resupply operations on a day to day basis will be more accurate than that obtained from fleet commanders or port descriptions that may not be up to date.

All data concerning current port structure and container handling capability must be evaluated in terms of capability of handling 40 foot containers. Additionally, projected flow rates must be developed for the movement of 40 foot

containers. It is recommended that International Standards Organization Technical Committee 104 (ISOTC 104) standards be used, except where further restrictions exist as a result of limitations imposed by either the point of origin of the cargo or the destination port itself.

The next grouping of current data that must be gathered concerns the current resupply requirements. This data which is available from the appropriate supply department/activity at each of the locations, must be broken down as to the following detailed categories: total quantity of cargo programmed for delivery in the current year (long ton and measurement ton); specific identification of requirements in terms of commodity, quantity and unit weight and cube; frequency of required resupply and breakdown by commodity type and amount included in each resupply activity; and a listing of all commodities required that are considered unsuitable for containerization.

The number of 20 foot containers programmed for delivery with each resupply operation needs to be obtained, along with projected contents and stowage of each. This information, which can be obtained from the supply depot providing resupply support for the destination location, should then be analysed for suitability of stowage in 40 foot containers. With the use of a computer program, projected stowage in 40 foot containers can be developed. Once this is done, the total number of 40 foot containers required, as well as container

utilization rates, can be obtained for each resupply action. The total number required and utilization rates with 40 foot containers should then be compared to the same information for 20 foot containers; any deficiencies that may result, as well as any improvements in efficiency, from the use of one size container or the other should be noted.

Once all of the current information has been obtained, it is necessary to look to projections of future operations and resupply requirements. This portion of the study will also be divided into two sections, the first concerning port structure and the second concerning resupply requirements. Anticipated growth and increased mission requirements must be carefully evaluated in terms of impact on existing port structure, cargo handling capability, and equipment requirements. Identification of requirements for upgrade of existing facilities and/or replacement of existing equipment must be evaluated in terms of impact on future throughput capabilities.

The impact on future throughput should be evaluated in terms of both the 20 foot containers and the 40 foot containers. Requirements for equipment upgrades, for example, should be evaluated in terms of capability of handling the larger containers as well as those currently in use. Upgrades or changes to existing road limitations must also be evaluated in terms of impact on the movement of the 40 foot containers, as well as for the currently used 20 foot size.

As a result of evaluation of future growth or projected changes to port structure and local infrastructure, flow rates should be developed for both the 20 foot and for the 40 foot containers. These flow rates will be used to compare the efficiency of future operations using either size of container.

The data necessary for this section of the study is best obtained from fleet commanders. Projected plans, as well as analysis of future needs within their areas of cognizance will provide the best estimates of future mission requirements. Additionally, projected Programmed Objectives Memorandum (POM) submissions will detail expected expansions of mission statements of fleet commanders who will in turn be able to translate these into changes to the mission statements of each of the locations under evaluation.

Future resupply requirements can be developed as a result of projected changes and/or growth of mission statements. These requirements, which need to be developed in the same detail as that provided for current requirements, must be evaluated in terms of both 20 foot and 40 foot containers. This information, which can be obtained from fleet commanders, will be in the form of estimates. As such, care must be taken that growth rates used are consistent with projected changes in mission statements.

The final group of data necessary for this study is that regarding vessel capability and availability (Figure 7). Again projections of shipping estimates that will be available

VARIABLE	ATTRIBUTE	MEASURE
MSC ships	Cargo configuration	20 ft. containers 40 ft. containers break bulk (m/t,l/t)*
	Cargo handling	number of cranes capacity
U.S. flag ships	Cargo configuration	20 ft. containers 40 ft. containers break bulk (m/t,l/t)*
	Cargo handling	number of cranes capacity
RRF	Cargo configurations	20 ft. containers 40 ft. containers break bulk (m/t,l/t)*
	Cargo handling	number of cranes capacity
SRF	Cargo configuration	20 ft. containers 40 ft. containers break bulk (m/t,l/t)*
	Cargo handling	number of cranes capacity

* m/t - measurement tons
  l/t - long tons

Figure 7. Assets Available

for use in conjunction with the military resupply of these locations must be developed. This information, which can be obtained from the Military Sealift Command (MSC), will be the result of industry survey and future projections of commercial requirements. In order to provide data for efficiency comparisons, capabilities for handling both 20 foot and 40 foot containers must be developed in terms of flow rates and total ship stowage capability.

The recommended format for the study of peacetime container operations is that of a computer generated spread sheet. By using this type of format, evaluation of the data will be simplified as all data will be displayed in similar format. All data concerning future projections in terms of port structure and capability and resupply requirements, as well as container assets necessary to deliver those requirements, will be available in terms of both 20 foot and 40 foot containers.

Evaluation of the data gathered will be based on determining at what point in the future, as a result of mission requirements and resulting upgrading of capabilities or simple replacement of existing equipment and facilities as a result of obsolescence, it will be more efficient for the required resupply to be conducted utilizing 40 foot containers. The point of efficiency will occur when better utilization of containers, equipment, and facility structures can be achieved using the larger container. This point of efficiency can

best be defined as greater utilization of container capacity, vessel capacity, and greater flowrates resulting from one size container as opposed to the other. It can be expected, for example, that best utilization of containers, equipment and existing structure can be obtained with the 20 foot containers now in use. Cargo quantities, equipment, capabilities and port structure in all four locations are geared towards the use of the 20 foot container. At some point in the future, however, it can reasonably be anticipated that this will change.

Analysis of the information obtained and the flowrates developed for both size containers may indicate, for example, at what point cargo handling equipment will be deficient in terms of reduced throughput of containers. This information will also indicate at what point in the future flowrates could be increased as a result of improvements in infrastructure. The value of this information is that it will provide military planners with projections of future need in terms of changes to existing peacetime container resupply operations.

2. Study of Contingency Container Operations

The first step in the development of this second major study is to determine what ports and locations military planners have identified for contingency resupply operations. Caution must be exercised in this, as the information to be used in many cases will simply be estimates or vague projections of possible operations. However, in order to fully

study the impact of the trend towards the 40 foot container, it is necessary that all possibilities of military contingency operations be thoroughly examined. It is anticipated that the list will be quite lengthy and that discrepancies regarding discharge locations will be found in the process of gathering the necessary data. Identification of these discharge ports and locations will come from contingency plans, the evaluation of those plans by fleet commanders, and projected changes as a result of the Joint Chiefs of Staff (JCS) prepared Joint Strategic Planning Document.

As in the development of the peacetime portion of this study, it is necessary to collect pertinent data concerning existing port structure and capabilities. It is recommended that this information be gathered from a variety of sources, including current reports issued by port authorities, reports from owners of vessels calling those ports, as well as military reports on current structure and capabilities.

Again, as with the peacetime portion of this study, information concerning port structure should be divided into two sections, that concerning the actual physical structure of the port and that concerning the capabilities of the port regarding containerization. All data gathered should be as detailed as possible, as this data will provide the baseline for this portion of the study.

The next step in this study is to gather all available data concerning the movement of containers, not only through the port itself, but also in-country. Road capabilities, limitations and specific details concerning terrain are pertinent. If contingency plans specify receipt locations or activities, all details concerning container movement and handling capabilities must also be gathered for these locations as well. The idea is to develop, in detail, information as to capabilities and flowrates, as complete a picture as possible of container operations for all contingency scenarios.

Once this information has been gathered, it is necessary to develop data concerning future development and operations for each of these locations. This information, which will be based on forecasts of future need as perceived by port authorities and fleet commanders (as concerns receipt activities), must be gathered from a variety of sources. Port authorities, while an excellent source, may not always have the complete picture concerning future requirements or trends in activity. Analysis of the port country's economy and trade forecasts, as well as analysis of past activity and growth rates, will all be necessary in order to provide as accurate a picture as possible. Additionally, military intelligence reports and analyses will help to round out the information obtained.

The most critical element in this portion of the study is to ensure that forecasts of future development, construction, and capabilities are as accurate as possible. It is vital that data collected not be overly optimistic in nature; however, credence must be given to forecasts of future growth. It is for this reason that information must be collected from as wide a variety of sources as possible.

All information concerning container handling and movement capabilities should be expressed in terms of size of container handled. For instance, if the current port structure is geared around 35 foot containers and there is no existing capability for the handling of 40 foot containers, this fact must be noted. Flowrates, expressed in terms of discharge and terminal throughput, should be noted for all container sizes available.

Once all data concerning port structure and container handling capabilities have been gathered, data concerning resupply requirements must also be obtained. This information which will come fron contingency plans, should be carefully reviewed to ensure that requirements are realistic and are based on recent projections. Data regarding requirements should be gathered in much the same format as that gathered for the peacetime portion of this study; total requirements are needed, but should be broken down to item description, weight, number required, suitability for containerization, and cube. In addition, load port and projected required delivery dates are necessary.

This data should then be analysed for ideal containerization stowage. Stow plans should be developed for optimum mix, using both 20 foot containers and 40 foot containers. Number of containers required, container utilization rates, and container load weight should be developed for all cargo requirements. This information should be developed for use with 20 foot containers as well as with the 40 foot size.

Data concerning the availability of military cargo handling equipment must be obtained. This information should be grouped according to each specified resupply destination. In the case of beachheads, it is important that mode of discharge be identified in detail, and that limitations associated with that mode of discharge be noted. For instance, if contingency plans call for the construction of a temporary pier with weight and width constraints, note must be made of this. If current military inventories do not include any floating cranes capable of handling fully loaded 40 foot containers, this must also be noted.

Along with the data concerning the capabilities of equipment currently in inventory and designated for contingency use, it is imperative that any plans for the upgrade of this equipment be noted. Of equal importance is to note the age of all equipment currently in inventory and to determine if projected replacement or conversion plans exist. If military planners are currently aware of replacement plans, details concerning capabilities and limitations of new equipment should be obtained.

This information should not be limited to port container handling equipment. Rather, information concerning the handling of containers and cargo once in the field needs to also be obtained. Type of equipment, number of units, as well as capabilities must be obtained for each contingency operation site. The existence of plans to upgrade or to replace already existing equipment must be analysed to determine capabilities or limitations of new equipment.

Information concerning vessel availability must be gathered. This information, which will cover vessels currently in or projected to be added to the Ready Reserve Fleet (RRF), the Strategic Reserve Fleet (SRF) and the commercial U. S. flag fleet, can best be obtained from the Maritime Administration (MARAD) and from the Military Sealift Command (MSC). Commercial ship owners will also be able to provide information concerning expected additions and conversions of their present fleets. Again, the data obtained must include detailed information concerning vessel capabilities for the handling of containers. If limitations exist, they must be identified.

The final step is to develop load plans based on cargo and vessel availability. Container handling and throughput rates need to be developed for each location designated to receive resupply cargo. These flowrates should be developed for delivery of both 20 foot and 40 foot containers.

Future projections of U. S. flag container fleet inventories and availability should be compared to projected requirements. In all cases where equipment and port structure capabilities indicate acceptability of accepting and handling 40 foot containers, note whould be made and flowrates determined. Forecasted inventories must be carefully compared to those projections where port structure or equipment capabilities limit the container size to 20 foot to ensure that no shortfalls exist.

Finally, analysis of throughput rates must be performed to determine whether or not military operations can be improved with the use of 40 foot containers. Part of the determination of this improvement will include a comparison of container utilization rates. Consideration must also be given to flowrates if total efficiency is to be obtained.

In many cases, however, the size of container selected will be determined purely on the capabilities of the equipment available to off-load and to move the containers to their ultimate destination. The attention of military planners should be directed, however, to all instances where efficiency is best obtained through the use of 40 foot containers but, as a result of equipment limitations, use is restricted to 20 foot containers.

3. Evaluation of Study Results

Once both portions of the study have been analysed for possible improvements of efficiency as a result of using 40 foot containers, a precise determination of the impact of

the trend toward 40 foot containers by the commercial industry can be developed. It can be expected, for example, that as cargo handling equipment is replaced in both the commercial and the military sectors, the equipment selected will have increased capabilities and will in fact be designed for the larger containers. The same is true for the composition of the U. S. flag fleet, from which resupply shipping will have to come.

The assumption is made that both the military and the commercial sectors will program periodic upgrades of port structure; it is logical to assume that these upgrades will consist, in part, of increasing cargo handling capabilities. Attention must be paid to determine if these upgrades will support 40 foot container operations.

Availability of containers will be the final evaluation point. If forecasts of the U. S. flag container fleet indicate decreasing numbers of 20 foot containers to the point where there are insufficient numbers available for projected military resupply requirements, there can be little point in arguing the impact that the trend towards the 40 foot container will have on military operations. The rate at which commercial container owners intend to replace 20 foot containers with 40 foot containers will determine the criticality of need for a decision by military planners as to the development of alternative containerization plans.

Careful note should be made of the comparison of container throughput rates and of container utilization rates for the two sizes of containers. If indications are that more efficient cargo operations can be obtained with one size over the other, military planners should take note of this and determine whether or not this improved efficiency may not constitute sufficient impetus to limit military operations to use of one size container or the other.

A prime example of this is time savings. In a contingency situation, time savings can be measured in terms of lives lost or saved. Study results may indicate that substantial time may be saved in the delivery of cargo to ultimate destination if 40 foot containers are used. If so, the savings in time may justify the problems inherent in using current modes of container handling when dealing with the larger containers. In the peacetime scenario, the increased efficiency of overall operations to be realized from the use of 40 foot containers in Antarctica, for instance, may not be sufficient to offset the difficulties inherent in upgrading pier capabilities and equipment currently in use.

It will be the job of the military planners and analysts to evaluate the results of the proposed study to determine what tradeoffs DOD can and should make regarding container size. The object of a study of this type is not to provide solutions; rather, its object is to provide a process of

evaluation that will facilitate the formulation of an appropriate and responsive solution.

B. DEVELOPMENT OF ALTERNATIVE SOLUTIONS

Given that the military is willing to acknowledge the existence of a trend on the part of the commercial ocean shipping industry to move towards the use of 40 foot containers, there exits options other than the conduct of a study such as that which has been developed here. Response alternatives available to DOD may be classed as the choice of either pro-active or reactive responses.

1. Pro-active Response

Choice of this response by the military would indicate a determination on the part of the military planners to prepare for the results of the indicated trend towards 40 foot containers. This response could take one of two directions: military planners could determine that, based on the information currently available to them concerning contingency requirements and the capability of current and forecasted equipment, the 20 foot container is the only size container that will adequately meet military contingency needs. Recognizing that all equipment currently in the DOD inventory is capable of handling 20 foot containers, that all commercial equipment currently in place anywhere in the world has the capability of handling 20 foot containers at the very least, this would appear to be a valid conclusion for military planners to draw. If this decision were made,

it is recommended that DOD purchase 20 foot containers in sufficient numbers to meet total forecasted contingency requirements.

The drawbacks to this solution are of two types; the first is a possible loss of improved container handling efficiency. If flowrates and container utilization rates indicate that military operations could be improved as a result of the larger container, DOD will have sacrificed these improvements in efficiency because it will have locked itself into the use of 20 foot containers. Additionally, the problem of vessel availability arises. Plans will have to be developed to ensure timely modification of all ships not designed to carry 20 foot containers.

The second type of problem is the size of the pool or number of containers. The number of containers identified as necessary for resupply operations will be a projection. In the event of a contingency, this pool may prove to be insufficient. If so, military planners will find themselves with cargo to move and no plans for moving it. Additionally, the problem of where to put the thousands of containers that would be in a pool of this type must be dealt with. The ideal location is close to the load port identified for contingency use. The question of which contingency must then be answered. One of the biggest problems is the amount of land that would be required to provide storage regardless of where they would eventually be stockpiled.

The second direction that a pro-active response could take would be for the military planners to determine that, as a result of the implications inherent in the trend by the commercial industry towards the 40 foot container, the military has little choice in the size of container available for its use in contingency. In this case, response would be based on the recognition that commercial assets must be relied on to provide the major share of both the ships and containers required to support contingency resupply requirements.

If this determination were made, the recommendation would be for the military to phase out the use of 20 foot containers from its contingency plans and to look for development of new plans utilizing the 40 foot container. This solution also has its inherent advantages and disadvantages. The advantages are assured compatibility with available commercial assets and guaranteed improved throughput.

But the disadvantages would appear to easily outweigh these advantages. First of all, there is no guarantee that local infrastructures and port capabilities will support 40 foot containers in all locations identified for contingency resupply. Secondly, improved throughput means very little if decreased container utilization results from the use of the larger container. Thirdly, it has yet to be established that the military can handle 40 foot containers under contingency conditions.

2. Reactive Response

If military planners elect a reactive response, the assumption inherent in this choice is that they do not feel that the trend by the commercial ocean shipping industry toward the 40 foot container is of sufficient strength to be of concern to them. In view of this, and in view of their expressed satisfaction with the use of 20 foot containers for military use in contingency resupply, there is no need for a plan of action to be developed, much less considered for implementation. An underlying assumption here is that the military is content to wait until there are more significant indications of such a trend before considering the use of 40 foot containers.

Upgrade of port facilities and in-place cargo handling equipment will not have an impact since peacetime military operated resupply will continue to be operated with 20 foot containers. Additionally, as long as resupply requirements do not experience an unanticipated major growth as a result of greatly expanded mission tasking, there will be no need to look at increasing the size of the already existing pool of military-owned containers. If such a need were to develop, military planners might find themselves faced with difficulties in procuring the number of 20 foot containers required.

The military reactive response will continue the status quo. If at some time in the future it becomes obvious to military planners that the 20 foot container has indeed been

replaced or is being replaced by the 40 foot container, action can be taken at that time to bring military container operations into alignment with commercial operations. Military plans can then be evaluated for contingency resupply using the 40 foot container. Only then when it is truly a necessity, will action be initiated to upgrade those locations currently served by military container service using 20 foot containers.

The advantage to this response is that the military can be assured of having more accurate information regarding the trend towards 40 foot containers when decisions are made in regards to the adoption of the military of this size of container for its use. Continued expertise in the handling of 20 foot containers under contingency operations will be gained. This additional expertise will stand the military in good stead when and if the larger containers are adopted. Additionally, the military will not have been involved in the upgrade of container handling equipment and of port structures until it has become necessary.

The disadvantage is that by waiting, the military may be too late to efficiently make the switch to the larger container. By not phasing in the upgraded equipment and improvements of port structure over time, they may find themselves operating with severe limitations imposed by lack of capability of both equipment and of port structure. Additionally, if contingency situations should develop, the military runs the risk of finding itself with outmoded and poorly conceived resupply plans. In short, there may not be the time available for the needed upgrades to be made.

VI. ANALYSIS OF SOLUTIONS

In the previous chapter, three alternate courses of action available to military planners regarding the trend by the commercial shipping industry to move towards the 40 foot container were discussed. Choice of a course of action is dependent on how the military planners choose to view this trend and what impact they forsee it having on the use of containerization by the military.

A. DISCUSSION

It must be pointed out that the trend by the commercial shipping industry to turn towards the use of the 40 foot container is not going to have an immediate impact on the composition of the commercial container fleet nor will it impact on the immediate availability of 20 foot containers. As the statistics show, the 20 foot container currently exists in numbers sufficient to warrant its consideration as the major container in use by the ocean shipping industry world-wide [Ref. 27:pp 72-73].

What is significant here is that this is the current status within the industry. Indications of a strong move towards the 40 foot container exist, both in changes of container fleet makeup and in the expressed forecasts and future

AD-A154 439 THE IMPACT ON MILITARY CONTAINERIZATION OF A TREND BY THE CIVILIAN SECTOR TOWARDS 40 FOOT CONTAINERS(U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA P R NESHIEM DEC 84 2/2

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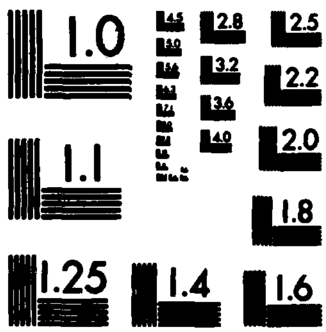

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

plans of the U. S. flag container fleet owners.[1] At what point, or even if the 40 foot container will actually become the dominant size container in use by commercial shippers is unknown at this time. This has shown that the trend is there and needs to be considered in its impact on current and palnned military usage of containerization.

For military planners to advocate a response of either pro-action or reaction would, at this time, be premature. Until the implications of this trend on military requirements and operations is understood, it is difficult to formulate an appropriate response. To make no response, however, is equally as dangerous; the development of plans and the procurement of equipment requires time, sometimes in amounts greater than the military has available.

Because of constraints imposed on the availability of funding and the necessity that those funds available be spent efficiently, to take immediate action in the procurement of mass numbers of containers is not feasible. Procurement action requires the careful identification of actual requirements. The total number of containers that will be required to handle total contingency resupply, much less the number of specific sized containers that would be required, is a

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[1]The movement toward the 40 foot container was discussed at length in Chapter 4, Section A, pp 34-46.

question that must give even the most optimistic of military planners pause. What to do about ships that may or may not be designed to carry a specific size container is another question for which answers must be found.

But the dangers of not preparing are just as grave. The interest in sealift and resupply generated by the Falkland Islands Conflict points directly to the dangers of complacency [Ref. 15:pp 12-15]. Believing that somehow everything will work itself out in the end can result in a most rude awakening, often with disastrous implications. To believe that the military can sit back and wait and see what will happen as a result of the trend towards the longer container may very well result in a response only at the time of contingency. If so, it will be too late at that time to correct any shortfalls or misfits of commercial assets with military requirements and capabilities.

It would appear that only one of the solutions proposed would be acceptable, given the nature of the problem. A feasibility study, if conducted in a thorough manner, would provide military planners with answers to all questions raised as a result of the implications inherent to a trend towards the 40 foot container. Some of these questions are: How well will commercial container assets meet military requirements? Will equipment capable of handling the larger containers be available? Will the military itself have equipment capable of handling the larger containers? What

impact will the larger containers have on the availability of ships? These are just a few of the many questions that military planners must have answers to before they can develop responsive plans of action.

Rather than requiring the expenditure of huge sums of money that may in the future turn out to have been unnecessary, a thorough study of the problem will lay the groundwork for the determination and development of a logical decision as to the direction the military ought to be taking in terms of container size. If, for instance, the study reveals that 20 foot containers are far and away the logical choice for the military, then steps can be taken to procure a pool of containers sufficient to meet contingency needs.

If, on the other hand, the results of the study indicate that 40 foot containers are all that are going to be available for contingency use, then the military can take steps to develop a means of efficiently handling that size of container. Rather than replacing current cargo handling equipment with new equipment of similar capability, the military will know that current capability must be expanded to meet the requirements of the larger containers. Rather than having to make these replacements all at once, the expense can be planned for and phased in over a period of time.

Planning for contingency requires more than simply writing plans and ensuring they mesh with one another. In the case of plans that require reliance on commercial as well as military

assets contingency planning means the careful monitoring of trends within the commercial sector. But even that monitoring is not adequate; evaluation of the future impact of trends within the commercial sector is critical, if responsive planning is to result.

B. CONCLUSION

In the beginning, containerization was a military concept. However, as the commercial world came to realize the benefits that could be gained in terms of reduced costs and greater cargo protection, commercial development and use of containerization far exceeded military involvement and interest. From the original 35 and 20 foot containers, the commercial sector is making the step to the 40 foot container, leaving behind all other variations of container length. For the military, however, once the initial step was taken and the results deemed satisfactory, interest in further development and use of containers apparently waned.

The military must, however, look beyond the 20 foot container, if for no other reason than the fact that U. S. flag assets, upon which contingency sealift and resupply must depend, may not be available. The argument that the 40 foot container is not compatible with either military cargo or with military operations is not valid if the only containers available are 40 foot containers.

Too many times in the past, the military has allowed itself to be caught off-guard in its contingency planning. Too many times in the past Congress has been able to accuse the military of impulsive action and a failure to accurately plan its purchases of equipment. The situation is developing for those same charges to be levied concerning contingency planning for the use of containerization.

The evidence is strong that the commercial ocean shipping industry is experiencing a strong move towards the 40 foot container. The time is now right for the military to prepare for the results of that trend. A study, designed to determine the impact on military use of containers for contingency resupply and the operation of its peacetime container resupply system, if conducted, would provide the military with the answers it needs in order to responsively plan for the future.

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